

Upper-Atmospheric Space and Earth Weather Experiment (USEWX)

Completed Technology Project (2013 - 2015)



Project Introduction

The USEWX project is seeking to monitor, record, and distribute atmospheric measurements of the radiation environment by installing a variety of dosimeters and other instrumentation on Armstrong aircraft. The goal is to routinely provide real-time, in-flight radiation measurements to modelers and the space-weather community. Radiation present in the upper atmosphere is harmful to humans and sensitive electronic equipment. Current radiation forecasting techniques employ data from satellites and ground-based detectors to predict radiation levels in flight. Aviation is trending toward flying at higher altitudes and over polar routes, where radiation events are more likely to occur and obtaining radiation data via traditional means is more difficult. Real-time, broad spectral-based radiation measurements are needed to improve radiation forecasts and space weather understanding.

Work to date: The USEWX team has cross-calibrated two gold-standard HAWK Tissue Equivalent Particle Counter (TEPC) dosimeters with the Airborne Radiation Measurements for Aviation Safety (ARMAS) Lite dosimeter in ground-based particle accelerators. The ARMAS Lite dosimeter was developed under the Small Business Innovation Research (SBIR) program and has been used to collect data on approximately 50 flights of an Armstrong DC-8 aircraft. Honeywell's Thermalized Neutron Measurement (TinMan) experiment has passed the System Safety Working Group (SSWG) review, will be tech briefed shortly, and should be flying before the end of the 2014. Construction of the ARMAS Lite Flight Module 3 and the TinMan have been completed, and both have been flown on NASA's ER-2 High-Altitude Airborne Science Aircraft.

Looking ahead: The HAWK TEPC dosimeters will be undergoing tech brief in mid-2015 for integration in the ER-2. The ER-2 will then be ready for supporting the Radiation And Dosimetry eXperiment (RAD-X) where the ER-2 will under fly the Langley Research Center high altitude balloon out of Fort Sumner, NM in September 2015. This work will capture a wide range of altitudes detecting radiation and categorizing a significant slice of the atmospheric radiation environment, something never done before.

The team will also be using the ARMAS-Lite Flight Module 5 as a self-contained, miniaturized, multiple power and data distribution (NASDAT and Iridium) unit capable of multiple platform dosimeter use. The ARMAS Lite FM 5 can be worn by pilots as well as flown as payload on high altitude balloons, the Armstrong Mars Prandtl-D (AMPD) glider, on any of AFRC's Airborne Sciences aircraft (DC-8, C-20, G-III, King- Air, ER-2), as well as on other AFRC aircraft (F-18, F-15) and on cubesats.

AFRC is also collaborating with Ames Research Center's Education and Intern group doing preliminary work ground work for the ARMAS Lite FM 5 for USEWX. In August 2015, interns from AFRC, ARC, Teachers in Space, USEWX, along with the Questforstars.com CEO and high school students from Earth To Sky Calculus will launch inexpensive dosimeters along with weather



Upper-Atmospheric Space and Earth Weather Experiment (USEWX) has applications for high altitude and polar-routed flights

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instrumentation, GoPro Cameras, multiple location devices, and chemical sensors on a weather balloon. The team will do a mobile weather balloon launch at a site determined by forecasted balloon trajectory provided by weather models and intends to aim for the Edwards Dry Lakebeds to ease in the payload recovery process and prove successful recovery of the payloads. This is preliminary work will pave the way to move the ARMAS Lite FM 5 to the AMPD glider and cubesats. Once the technique is perfected, the team will move to launching the more expensive ARMAS Lite FM-5 on either/both the weather balloons and AMPD glider.

Plans are also underway to:

- Install dosimeters on numerous Armstrong aircraft that fly in the upper atmosphere, including Gulfstream-III, F-18, and F-15 aircraft
- Integrate new dosimeters into radiosondes and rocketsondes
- Compare preflight space-weather forecast models with post-flight radiation data in order to refine and improve modeling

Partners: Space Environment Technologies LLC, Honeywell, Prairie View A&M University, and the German Aerospace Center (DLR)

NASA Partners: Ames Research Center, Langley Research Center, Goddard Space Flight Center, and Marshall Space Flight Center

Benefits:

- **Provides access to critical data:** Provides radiation data for the purposes of guarding against human dosing, radio blackouts, Global Positioning System (GPS) navigation errors, and single event effects (SEEs) for sensitive instrumentation
- **Improves safety:** Identifies radiation limits for humans and instrumentation
- **Enables improved modeling:** Facilitates radiation forecasts for human dosing and instrumentation SEEs

Applications:

- Radiation shielding materials for space exploration missions
- Real-time SEE monitoring
- Radiation dosing research for polar-routed aircraft

Anticipated Benefits

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Center Innovation Fund: AFRC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

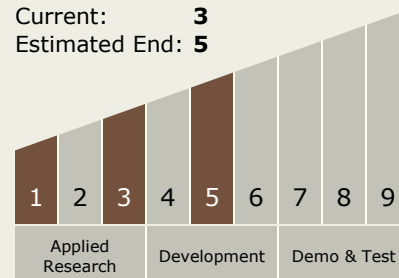
David F Voracek

Principal Investigator:

Scott L Wiley

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **5**



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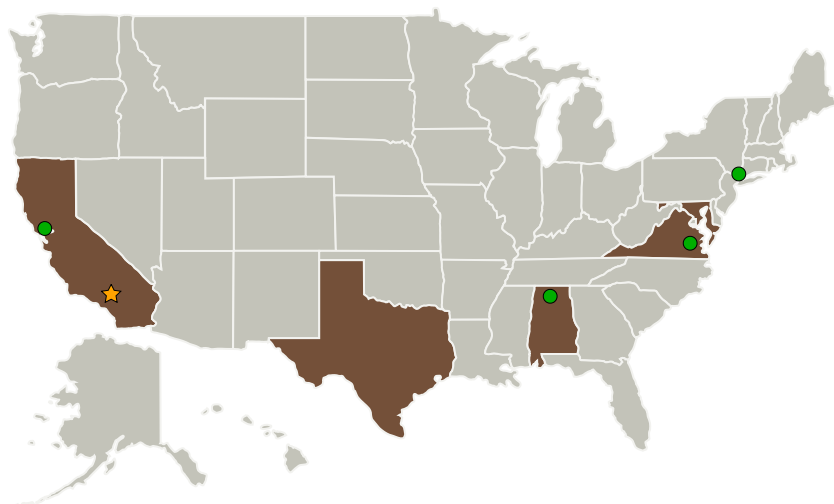
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Technology Areas

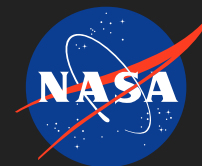
Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.5 Radiation
 - └ TX06.5.5 Monitoring Technology

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
●Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
●Goddard Institute of Space Studies(GISS)	Supporting Organization	NASA Facility	New York, New York
Honeywell International	Supporting Organization	Industry	
●Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
●Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
Prairie View A & M University	Supporting Organization	Academia	Prairie View, Texas
Space Environment Technologies, LLC	Supporting Organization	Industry	Pacific Palisades, California

Co-Funding Partners	Type	Location
German Aerospace Agency(DLR)	International	Cologne, Outside the United States, Germany

Primary U.S. Work Locations	
Alabama	California
Maryland	Texas
Virginia	

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Images



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